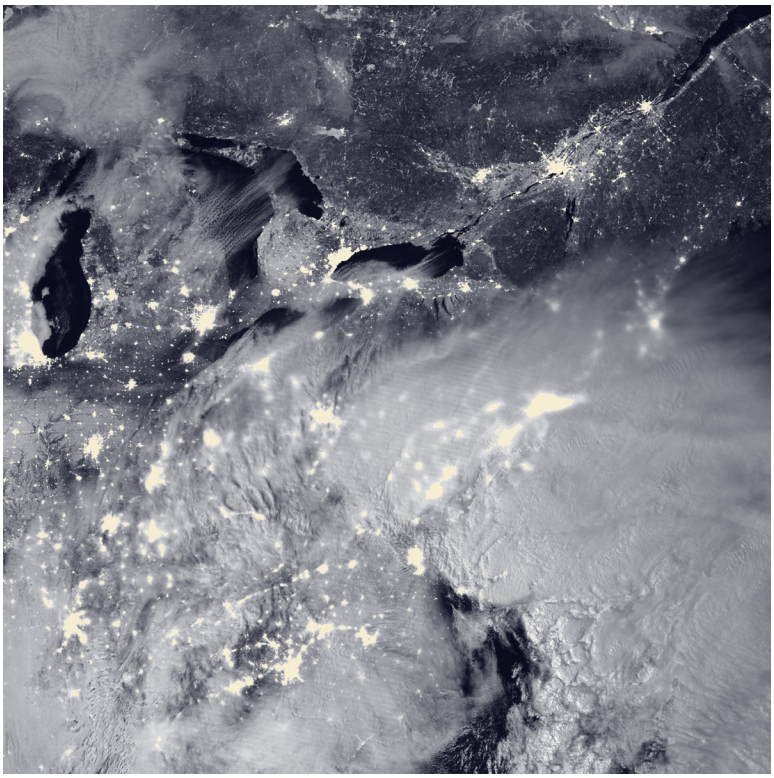

1 INTRODUCTION

INTRODUCTION

The global environment is changing rapidly. This century has seen 15 of the 16 warmest years since adequate thermometer records became available in the late 1800s; globally-averaged temperatures in 2015 shattered the previous record, which was set in 2014[1]; and 2016 is on track to break the 2015 record[2]. Arctic sea-ice extent continues a dramatic, decades-long decline[3]. Many independent lines of evidence show a long-term warming trend driven by human activities, with cascading impacts that may outpace the ability of human and natural systems to adapt to change[4].

The impacts of global climate change interact with existing and evolving socioeconomic and environmental stressors, creating complex challenges for society. New research confirms that climate change will heighten risks to human health, which are likely to disproportionately impact many already-disadvantaged communities and individuals[5]. More frequent and more intense extreme weather and climatic events are threatening food security, infrastructure, and livelihoods[6]. Communities around the world are facing rising seas and higher coastal flooding risk, impacts that will intensify over the coming decades[7]. These impacts, separately and in combination, pose increasing risks to international stability and national security[8]. Of course, adaptation to, and mitigation of, climate change may also create certain long-term benefits and economic opportunities—such as building community resilience to extreme weather events and developing renewable energy technologies—but will require planning and investment.

Scientific understanding of how the climate is changing and how climate change interacts with other Earth-system dynamics underpins the Nation's ability to respond to change. For over 25 years, the U.S. Global Change Research Program (USGCRP or "the Program") has been at the center of the Federal government's efforts to fulfill this critical need. Created by President Ronald Reagan in 1989 and codified by Congress in the Global Change Research Act (GCRA) of 1990[9], USGCRP has led advances in Earth-system science and expansion of the knowledge base needed to respond to a changing world. The Program's extensive body of work is carried out by 13 Federal agencies that conduct or use global-change research *(Figure 1: USGCRP Member Agencies)*, each contributing its distinct expertise while working together in a unified framework under the direction of the Subcommittee on Global Change Research (SGCR), which is overseen by the White House Committee on Environment, Natural Resources, and Sustainability (CENRS). USGCRP fulfills the mandate of the GCRA, executes the National Global Change Research Plan of 2012–2021 (hereafter, the 2012–2021

Figure 1:
USGCRP Member Agencies

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of the Interior
- Department of State
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- Smithsonian Institution
- Department of Energy

Strategic Plan, *(Figure 2: The U.S. Global Change Research Program at a Glance)*, and contributes to the research and decision-support goals of the President's Climate Action Plan (CAP). Through the SGCR, USGCRP collaborates with other subgroups of CENRS, including those focused on Earth observations, ocean science, and Arctic research policy.

USGCRP agencies conduct fundamental research to understand the interacting processes that constitute the dynamic Earth system, which encompasses the atmosphere, oceans, land, ice, ecosystems, and human systems. Climate change is an essential focus of the Program, but USGCRP's mandate also encompasses global environmental changes related to, interacting with, or associated with climate—including agricultural land use, pollution, biodiversity loss, and energy production—that have implications for climate and society. USGCRP's fundamental research supports its mission and goals to inform responses to change through sustained scientific assessment, actionable science and decision support, and engagement and education *(Figure 2: The U.S. Global Change Research Program at a Glance)*.

Since USGCRP's inception, Federal global-change research programs have created and maintained atmospheric, oceanic, land, and space-based observing systems that generate a wealth of data and information about our changing planet *(Appendix III. Observations to Support Global-Change Research)*, and have driven major advances in understanding of Earth's climate and environment and the ability to model how they change over time. These investments support a sustained scientific assessment and engagement process that underpins the ability to inform responses to change. With the 2012–2021 Strategic Plan, USGCRP seeks to balance its basic science mission with the Nation's increasing needs for decision support, sustained scientific assessment, and engagement and education on global change.

Figure 2: The U.S. Global Change Research Program at a Glance

USGCRP coordinates and integrates scientific research across 13 Federal agencies whose missions include understanding changes in the global environment and their implications for society. It was established by a Presidential Initiative in 1989 and codified by Congress in the Global Change Research Act of 1990 "*to assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change*."

Vision: A Nation, globally engaged and guided by science, meeting the challenges of climate and global change.

Mission: To build a knowledge base that informs human responses to climate and global change through coordinated and integrated Federal programs of research, education, communication, and decision support.

Strategic Goals: USGCRP's 2012–2021 Strategic Plan maintains a clear emphasis on advancing global-change science; it also calls for a strengthened focus on ensuring that USGCRP science informs decisions and actions that respond to global change. USGCRP's four strategic goals are as follows:

Advance Science. Advance scientific knowledge of the integrated natural and human components of the Earth system.

Inform Decisions. Provide the scientific basis to inform and enable timely decisions on adaptation and mitigation.

Conduct Sustained Assessments. Build sustained assessment capacity that improves the Nation's ability to understand, anticipate, and respond to global-change impacts and vulnerabilities.

Communicate and Educate. Advance communications and education to broaden public understanding of global change and develop the scientific workforce of the future.

In addition to the formal research contributions from its 13 member agencies, USGCRP cooperates with and leverages expertise from other Federal agencies and Programs that have an interest in understanding and responding to global change. This collaborative approach is facilitated by interagency working groups (IWGs) coordinated through USGCRP, with participants from USGCRP member agencies and 20 non-member Federal agencies. IWGs provide a framework for coordinating research efficiently, and a forum for exchange of knowledge and research needs among agencies studying global change and those responding to its impacts.

This report provides an overview of USGCRP's priority activities, with examples of recent progress in delivering on the goals of 2012–2021 Strategic Plan *(Figure 3: USGCRP Accomplishments under the 2012-2021 Strategic Plan)*, and in meeting research priorities that intersect with the President's CAP. It also provides an outlook on current activities and future directions within research priorities for Fiscal Year (FY) 2017 *(A Look Ahead at FY 2017)*, and supporting budgetary information *(Budget Information)*.

Figure 3: USGCRP Accomplishments under the 2012-2021 Strategic Plan

- Delivery of the Third National Climate Assessment, the most comprehensive analysis to date of how climate change is affecting the United States and how it could affect it in the future, and development of a sustained approach to climate-change assessment that includes strong stakeholder engagement
- Delivery of The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, a significant advancement in understanding of the impacts of climate change on human health that will contribute to the Fourth National Climate Assessment
- Production of actionable science that has informed policy decisions such as the President's Climate Action Plan of 2013, and provided the science that EPA considered in its 2016 endangerment finding for aircraft greenhouse gas emissions under the Clean Air Act
- Coordination of sustained observational campaigns to track global change and its impacts (*Appendix III. Observations to Support Global-Change Research*)
- Pioneering research on changing patterns of severe weather due to climate change
- Leadership of interagency reviews and author nominations for the Intergovernmental Panel on Climate Change assessment reports
- Contributions to Federal climate-related decision-support tools, including the Climate Resilience Toolkit and the Climate Data Initiative
- Convening of the first and second annual U.S. Climate Modeling Summit, bringing together the leaders of the six major U.S. modeling centers to promote collaboration and advancement in modeling the impacts of climate change.